

Response Under 37 CFR 1.116

Expedited Procedure

Examining Group 1700

Application No.: 10/624,921

Paper Dated: January 10, 2007

In Reply to USPTO Correspondence of July 10, 2006

Attorney Docket No. 2398-031312

REMARKS

Claims 1-3, 5-7, 9, 11-15, 17 and 18 are currently pending in this application. This Amendment amends the specification, claims 1 and 13-15 and adds new claims 20 and 23. Support for the amendments to the specification, claims and new claims can be found in the specification, drawings and claims as originally filed. No new matter has been added.

The Examiner did not acknowledge a claim of priority to the provisional application in this Office Action. Applicant respectfully requests that the Examiner acknowledge our claim of priority to United States Provisional Application No. 60/397,629 filed July 22, 2002, as indicated on page 1, paragraph [0001] of the present application and in Paragraph 5 of the filed Declaration and Power of Attorney.

The specification has been amended to include language that is consistent with the amended claims.

The present invention, as claimed in amended independent claim 1, is directed to a magnetron sputtering electrode for use with a magnetron sputtering device. The magnetron sputtering electrode includes a cathode body, a rotary drive unit coupled to the cathode body, a target having an outer edge received by the cathode body and a closed magnet arrangement received within a magnet receiving chamber and coupled to the drive unit. The closed magnet arrangement is comprised of a plurality of magnets adapted for motion relative to the target by the drive unit, wherein at least one of the plurality of magnets is a profiled magnet. The profiled magnet having a contoured top portion and defining an apex is positioned adjacent to the outer edge of the target. The electrode further includes a support plate coupled to the rotary drive unit, wherein the support plate includes one or more spacer blocks situated on the support plate, wherein the spacer blocks are constructed of non-magnetic material. The plurality of magnets are arranged on the support plate such that a portion of the contoured top portion of each of the plurality of magnets is positioned beneath an upper surface of the spacer blocks, and wherein the rotary drive unit rotates the magnet arrangement, whereby the motion further comprises two or more rotational degrees of freedom of movement about an axis.

35 U.S.C. § 103 Rejections

The Examiner has finally rejected claims 1-3, 5-7, 9 and 11-13 under 35 U.S.C. §103(a) for obviousness over newly cited U.S. Patent No. 5,944,968 to Kobayashi et

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al. (hereinafter “the Kobayashi patent”) in view of previously cited Japanese Patent 61-235560 to Masaki et al. (hereinafter “the Masaki patent”) and U.S. Patent No. 4,631,106 to Nakazato et al. (hereinafter “the Nakazato patent”). Claims 14, 15, 17 and 18 stand finally rejected under 35 U.S.C. §103(a) for obviousness over the Kobayashi patent in view of the Masaki patent and the Nakazato patent and further in view of Japanese Patent No. 61-041194 to Fukami et al. (hereinafter “the Fukami patent”). See pages 2-8 of the Office Action. In response, independent claims 1, 13 and 15 have been amended wherein the apex of at least one of the profiled magnets is positioned adjacent to an outer edge of the target. Claim 14 has been amended for better clarification. Support for the amendments to the claims can be found, for example, in Fig. 1 of the drawings and in paragraph [0029] on pages 6-7 of the present specification as originally filed. As discussed below in detail, none of the cited prior art teaches or suggests a magnet arrangement for a rotary magnetron wherein an apex of at least one of the profiled magnets is positioned adjacent to the outer edge of the target and the new and unexpected results associated with the claimed arrangement.

The electrode of the present invention uses profiled magnets in a rotary magnetron design thus resulting in new and unexpected advantages that the prior art does not have. These new and unexpected results achieved by the present invention extend beyond the known advantages associated with the use of profiled magnets in non-rotary magnetron designs as attested to in the attached Declaration of Mark A. Bernick. First, the use of profiled magnets in rotary magnetron designs resulted in an increase in target utilization ranging from 50% to 60%, which is far beyond what is typically expected of profiled magnets used in non-rotary magnetrons. Secondly, because a portion of the contoured top portion of the profiled magnets is either at or extends slightly beyond the outer edge of the target, the magnetic field lines are spread over the entire surface of the target, thus reducing the amount of the “dark space” or non-active area on the target as shown in Exhibit B of Mr. Bernick’s Declaration. This reduction in dark space on the target translates into a reduction in particulate contamination which occurs primarily in the dark space wherein redeposition causes particles to flake off from the dark space and contaminate the substrate. Thirdly, the use of profiled magnets in rotary magnetron designs resulted in a significant reduction in target size in contrast to the size of the target for equivalent prior art (i.e., flat magnets) rotary magnetron designs. This translates into less chamber volume, less floor space and decreased

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target cost. Lastly, the use of these profiled magnets in a rotary magnetron design of the present invention resulted in either a 20% power reduction or a 20% increase in deposition rate in contrast to a comparable prior art rotary magnetron without profiled magnets. This power reduction translates into a 20% energy savings, and the increased rate translates into faster cycle times and higher pump speeds for the claimed magnetron arrangement.

The Kobayashi patent discloses a sputtering arrangement in which a magnet assembly is rotatable around an axis thereof and also around an axis of a corresponding target. A mechanism is responsible for varying the eccentric distance between the two axes (See Fig. 2 and column 3, line 63 to column 4, line 7). Fig. 2 shows a target 5 having a sleeve 51 in which the magnet assembly 4 is provided (column 5, lines 23-24). The end of the magnet assembly 4 is spaced a considerable distance from the outer edge of the target 5 (Fig. 2). Further, Figs. 4a-c show various patterns of a magnetic field applied by rotating and revolving the magnetic assembly 4 on a target. These erosion patterns on the target are also spaced a considerable distance from the outer edge of the target. Therefore, the Kobayashi patent does not teach or suggest the use of profiled magnets or a portion of a contoured top portion of a magnet positioned at or extending beyond the outer edge of the target as claimed or the new and unexpected results as discussed above.

The Masaki patent is directed to a magnetron sputtering device wherein a "magnet 4 is at the same time moved back and forth at a specified period in an arrow A direction by a horizontal moving mechanism 41 with respect to the target 3..." As shown in the figure, the magnet 4 is contained in a target support in parallel with a target surface. The target support prevents any part of the magnets from moving near the outer edge of the target 3. Therefore, the Masaki patent does not teach or suggest a portion of a contoured top portion of a profiled magnet positioned at or extending beyond the outer edge of the target as claimed or the new and unexpected results as discussed above.

The Nakazato patent is directed to a plasma processor comprising a processing chamber, means to reduce a pressure in the processing chamber, means to introduce a processing gas into the chamber, means to produce an electric field within the chamber, and means to establish a magnetic field orthogonal to the electric field, wherein a magnet element 60 is disposed so as to be rotatable within a plane orthogonal to an electric field. The magnet element 60 is coaxial with, for example, the wafer setting surface of the electrode and is fixed

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to the upper end of a rotary shaft 70 (See Abstract, Fig. 1 and column 4, lines 12-17). Fig. 1 of the Nakazato patent shows an outer edge of the target (i.e. electrode 30) extending beyond the upper end of the rotary shaft 70 where the magnet element 60 is attached thereto. Therefore, the Nakazato patent does not teach or suggest a portion of a contoured top portion of a profiled magnet positioned at or extending beyond the outer edge of the target as claimed or the new and unexpected results as discussed above.

The Examiner cites the Fukami patent for the asserted teaching of the apexes of the magnetic poles being up to half the thickness of the magnet segment. The Fukami patent does not teach or suggest (1) a rotary magnetron, (2) a magnet arrangement having two or more rotational degrees of freedom of movement about an axis as claimed, or (3) the new and unexpected results associated with the use and position of profiled magnets in a rotary magnetron.

Evidence of commercial success can also be strong evidence that the invention was not obvious to those skilled in the art at the time the invention was made. *See In re Tiffin*, 443 F.2d 394, 398, 170 U.S.P.Q. 88, 91 (C.C.P.A. 1971); *Glaxo Wellcome, Inc. v. Pharmadyne Corp.*, 32 F. Supp. 2d 265, 303 (D.Md. 1998). The fact that the claimed magnetron arrangement has had commercial success, as attested to in the Declaration of Mark A. Bernick, further establishes that the use and position of the profiled magnets in the claimed rotary magnetron design was not obvious to those skilled in the art at the time the invention was made. For example, on pages 3 and 4, items 8 and 9 of the Declaration of Mark A. Bernick, Mr. Bernick states that over 30 of the claimed magnetron arrangements have been sold to date with little to no advertising because of the novel design features and the advantages associated therewith. Furthermore, Mr. Bernick states the claimed magnetron arrangements are the only ones available in the marketplace.

Because the claimed magnetron arrangement has had commercial success in the magnetron industry, the use and position of profiled magnets in a rotary magnetron design in accordance with the present invention would not have been obvious to one of ordinary skill in the art at the time the invention was made.

Because none of the cited prior art references teaches or suggests a magnet arrangement for a rotary magnetron wherein an apex of at least one of the profiled magnets is positioned adjacent to the outer edge of the target or the advantages associated with the use

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and position of the profiled magnets, the Applicant believes that the subject matter of amended independent claims 1, 13 and 15 and dependent claims 2, 3, 5-7, 9, 11, 12, 14, 17 and 18 is distinguishable over the cited prior art.

New Claims

New dependent claims 20 and 22 have been added to limit further the position of the profiled magnets; for example, "wherein a portion of the apex of the profiled magnet is positioned at the outer edge of the target." New dependent claims 21 and 23 have been added to limit further the position of the profiled magnets; for example, "wherein a portion of the apex of the profiled magnet extends beyond the outer edge of the target." Support for new claims 20-23 can be found, for example, in Fig. 1 of the drawings and in paragraph [0029] on pages 6-7 of the present specification as originally filed.

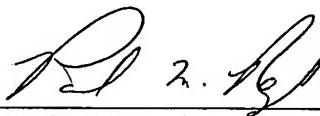
CONCLUSION

Based on the foregoing amendments, remarks and the enclosed Declarations under 37 CFR § 1.132, withdrawal of the rejections and allowance of pending claims 1-3, 5-7, 9, 11-15, 17 and 18 and new claims 20-23 are respectfully requested. Entry of the amendments to the specification, claims and new claims are respectfully requested.

Respectfully submitted,

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